Welcome to the US Army Corps of Engineers
Vicksburg District

Avian Vacuolar Myelinopathy

Welcome to the Avian Vacuolar Myelinopathy (AVM) interagency website. AVM, formerly known as Coot and Eagle Brain Lesion Syndrome (CEBLS), is an avian disease that is believed to be caused by a neurotoxin of unknown origin. It causes lesions (open spaces) in the white matter of the brain and in the spinal cord of affected birds. Affected birds have difficulty flying, walking and swimming. AVM is the most significant unknown cause of eagle mortality in the history of the United States.

Information about AVM has been organized to assist you in learning about this disease that has killed bald eagles, American coots and several species of ducks across the South. We encourage you to discover how to identify signs of the disease in wild birds, where AVM has been found, how researchers are working to solve this wildlife mystery, and how you can assist in the study efforts. Select the topics of interest to you in the left-hand column to view narrative, photographs and video clips concerning AVM. A PDF file is also provided to print the contents of the entire site.

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Affected Birds

AVM was initially confirmed in Bald eagles *(Haliaeetus leucocephalus)* and in American coots *(Fulica americana)* by the US Geological Survey National Wildlife Health Center (USGS NWHC) in the fall and winter of 1994. As the name change indicates, AVM continues to evolve. It was confirmed in several duck species in 1999 by NWHC and the University of Georgia's Southeastern Cooperative Wildlife Disease Study (SCWDS). These species include Mallard *(Anas platyrhynchos)* and Ring-necked ducks *(Aythya collaris)*. Lesions consistent with the disease were also found in Bufflehead *(Bucephala albeola)* and American Wigeon *(Anas americana)* ducks, and in Canada geese (Branta canadensis). AVM was confirmed in a Canada goose (Branta canadensis) in the winter of 2000-01.

Affected Coot

Click to Enlarge

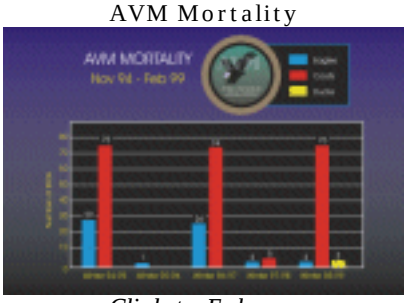
Locations and Mortality

Site Map

Click to Enlarge

AVM was discovered in Arkansas in 1994 when 29 bald eagles were found dead during the fall and winter at DeGray Lake in southwestern Arkansas. Another significant eagle die-off occurred at DeGray and at 2 nearby Arkansas lakes in the winter of 1996-97 when 26 eagles and numerous coots died. Affected coots were confirmed outside of Arkansas in 1998 on lakes in Georgia and North Carolina. In the winter of 1998-99, USGS NWHC scientists confirmed AVM in waterfowl and other species.

AVM Mortality



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This included small numbers of mallards and ring-necked ducks in North Carolina, 4 bald eagles from Georgia, North and South Carolina, and affected coots at new sites in South Carolina and Georgia. A few hundred coots are believed to have died from AVM annually.

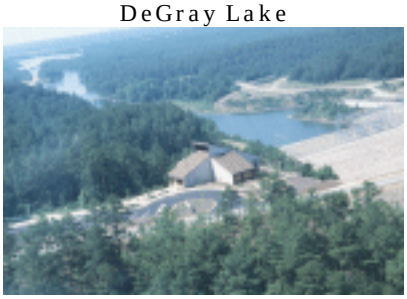
In the winter of 1999-00, AVM was confirmed in 4 eagles from Lake Ouachita, Arkansas; 1 eagle from Lake J. Strom Thurmond, South Carolina; 1 eagle from Lake Greeson, Arkansas; and in American coots from Lake Surf (Woodlake), North Carolina, DeGray Lake and Lake Ouachita, Arkansas, Lake Juliette in Georgia, and Lake J. Strom Thurmond, Lake Murray, Par Pond and L-Lake (Savannah River site) in South Carolina. Accurate coot counts are hampered by natural factors such as large populations of predators and scavengers at lakes with AVM. As mentioned earlier, bufflehead and wigeon ducks from North Carolina, and Canada geese from Georgia may have also been affected by AVM. Records research conducted in 1999 revealed that AVM may have occurred in North Carolina as early as 1990. : Bird mortality in the winter of 2000-01 includes AVM confirmation in coots at Lake Juliette, GA; in coots and in mallard ducks introduced for research purposes at Lake Surf (Woodlake), NC; and in eagles, coots and a Canada goose at J Strom Thurmond Lake in SC/GA.

Site Descriptions

Arkansas: AVM was first documented at DeGray Lake near Arkadelphia, Arkansas in November 1994. DeGray is a 13,800-acre lake under the management of the Vicksburg District, US Army Corps of Engineers (USACE).

Lake Ouachita

DeGray Lake



During the winter of 1995-96, an eagle with AVM was discovered at Lake Ouachita near Hot Springs, Arkansas. Lake Ouachita is a 40,060-acre lake that is also managed by the Vicksburg District. Project purposes for both reservoirs include flood control, hydropower production, recreation, water supply, and management of fish, wildlife and forest resources. Fish and wildlife management is performed in partnership with the Arkansas Game and Fish Commission. In the winter of 1996-97, AVM resulted in eagle and coot mortality at lakes DeGray and Ouachita.

Lake Hamilton

Lake Greeson

An AVM eagle was also found at Lake Hamilton, a 7,200-acre utility reservoir operated by Entergy Corporation near Hot Springs, Arkansas. Hamilton has similar project purposes. In the winter of 1998-99, AVM American coot deaths were confirmed at Lake Ouachita. In the winter of 1999-00, AVM was confirmed in 4 eagles from Lake Ouachita; in coots from DeGray Lake and Lake Ouachita; and in 1 eagle from Lake Greeson. Lake Greeson is a 7,260-acre lake managed by the Vicksburg District with project purposes similar to DeGray and Ouachita.

Lake Juliette

Georgia: During the winters of 1997-98 and 1999-00, affected coots were discovered at Lake Juliette near Forsyth, Georgia, a 3,500-acre reservoir that is owned by Georgia Power Company. The Georgia Department of Natural Resources (GDNR) manages the lake for waterfowl hunting and fishing. Juliette serves as a source of water for cooling towers of a coal-fired power plant. During the winter of 2000-01, AVM was confirmed in coots.

Lake Surf or Woodlake

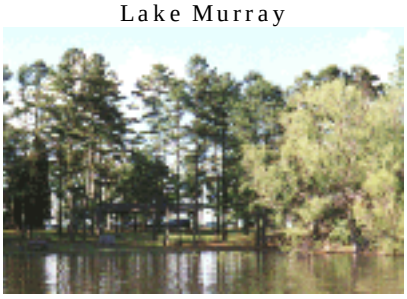
North Carolina: The winters of 1997-98 and 1999-00 also produced affected coots at Lake Surf (Woodlake) in North Carolina. Lake Surf is an 1,130-acre reservoir that is part of the Woodlake Country Club development in Vass, North Carolina. During the winter of 2000-01, AVM was confirmed in coots and in mallard ducks introduced for research purposes.

J. Strom Thurmond Lake

South Carolina: In the winters of 1998-99 and 1999-00, bird deaths from AVM were confirmed at J. Strom Thurmond Lake (bald eagle in 1999-00) on the border of South Carolina and Georgia, on Lake Murray in South Carolina and on Par Pond and L-Lake within the Department of Energy's Savannah River Site in Aiken, South Carolina. Thurmond is a 70,000-acre reservoir managed by the Savannah District, US Army Corps of Engineers. Management of fish and wildlife resources is performed in partnership with the Georgia and South Carolina Departments of Natural Resources

(SCDNR). Project purposes are similar to those listed for the other Corps

Lake Murray



Par Pond

reservoirs. During the winter of 2000-01, AVM was confirmed in a Canada goose, coots, and is suspected in the deaths of 11 bald eagles (some confirmed, some specimens unsuitable for confirmation). Lake Murray is a 50,800-acre lake managed by the South Carolina Electric & Gas Company near Columbia, South Carolina. Fish and wildlife resources are managed by the SCDNR. Par Pond is a 2,640-acre recirculating cooling water pond that is used to dissipate heated effluents from nuclear production reactors. Scientists from the Savannah River Ecology Lab conduct research at this and adjacent sites.

Sam Rayburn Lake

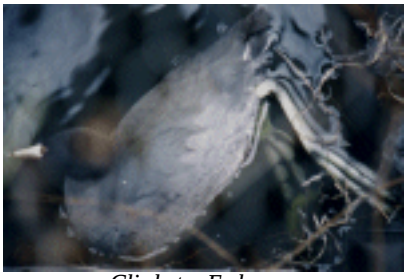
Texas: The winter of 1999-00 produced coots with mild lesions consistent with AVM at Sam Rayburn Reservoir in Texas. Sam Rayburn is a 114,500-acre lake under the management of the Fort Worth District, US Army Corps of Engineers. Project purpose include flood control, hydropower production, and conservation of water for municipal, industrial, agricultural and recreational uses.

Common Features: All current AVM sites are manmade impoundments. Other similarities include relatively good water quality, the presence of macrophytic and epiphytic aquatic vegetation (particularly *Hydrilla verticillata*, *Egeria densa* and *Entophysalis*), and wintering populations of water birds and eagles.

Clinical Signs

Water birds with AVM demonstrate a reluctance to fly, erratic flight with the posterior of the bird bobbing down while flying, and an inability to fly. Eagles have been observed flying into trees and rock ledges.

Affected Coot



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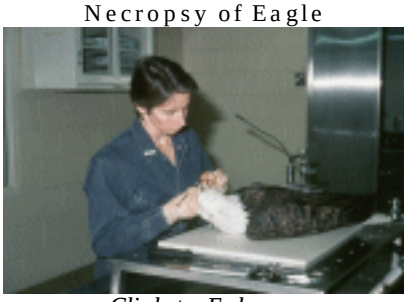
While swimming, birds often demonstrate a partial paralysis on one side of the body that may result in swimming with one leg extended, swimming in circles, and swimming upside down. On the ground, waterfowl and eagles stumble and wobble. Of these clinical signs, swimming with an extended limb, swimming in circles, staggering on land, and very erratic flying are the most reliable diagnostic factors. Results from an ongoing epidemiological study have also found AVM lesions in coots with no apparent clinical signs. A few sick eagles have been captured and transported to veterinary clinics for treatment, but all of these birds have died within 1-2 days of capture despite medical assistance. The majority of affected eagles have been found dead, often near roost sites. Sick or dead AVM birds are usually found between October and March with a peak from mid-November through early December.

Diagnostic Results

Necropsy of Eagle



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Since AVM affects the delicate Central Nervous System, bird specimens that have been frozen or are in an advanced state of decomposition cannot be used for accurate diagnosis of the disease. Dead AVM birds appear to be in good body condition and have no visible external or internal changes with the exception of microscopic neural lesions. Electron microscopy is used to confirm the disease in new species and at new locations. A naturally occurring or manmade toxin is the most probable cause of the lesions. Tests for a wide range of known toxins such as pesticides and heavy metals have resulted in no significant findings. Chemicals that are known to create a similar lesion include triethyl tin, bromethylene and extracts from toxic plants that grow in Africa and Australia, but tests for these compounds have been negative. There has also been no evidence of infectious disease caused by viruses, bacteria or prions (mad cow-type disease).

Research Efforts

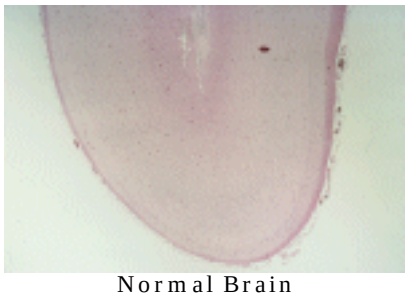
Many different research efforts have been completed or are in progress. These include:

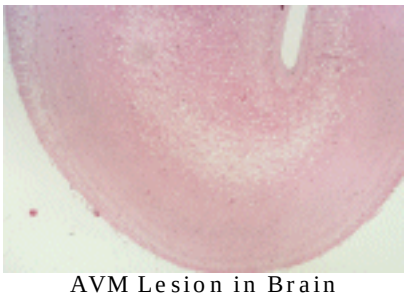
- Clinical avian feeding trials involving quail, kestrels, coots, and domestic chickens with food sources of bass, shad, catfish, *Egeria*, *Lemna*, lake scum, and affected coot gastrointestinal contents and muscle tissue and a sentinel coot and mallard study by the USGS National Wildlife Health Center. So far, the sentinel study has confirmed that the disease is site-specific, i.e., the lakes where the birds are dying is the site of exposure. New feeding trials are also underway to try and determine the route of exposure.
- Water quality analysis by the Corps of Engineers and Ouachita Baptist University.
- Bald eagle movement and feeding behavior studies by Arkansas State University.
- American coot banding and movement monitoring by USACE, the Arkansas Game & Fish Commission and Ouachita Baptist University.
- Toxicology analysis of affected avian tissues by the National Center for Toxicological Research.
- Collection and analysis of plankton and aquatic plants by Henderson State University. This study is currently being expanded to identify common macrophytes and epiphytes at all AVM sites and potential toxicity associated with them.
- Aquatic and upland plant inventories by the Arkansas Natural Heritage Commission, and Henderson State University.
- Preparation of a Geographical Information System database by the University of Georgia and FTN & Associates.
- Foraging Ecology of American coots by Texas A&M University.
- Multi-state epidemiological investigation by the University of Georgia's Southeastern Cooperative Wildlife Disease Study. States sampled include AL, AR, CA, FL, GA, KY, LA, MD, MS, MI, NC, SC, TN, TX and VA.
- Sediment analysis at all AVM sites by USFWS to identify potential contaminants.

Research Photos

Click Image to Enlarge


Nesting Eagle


Normal Brain


AVM Lesion in Brain


Toxicology Lab


Eagle Handling Training


Trapping Live Eagles


Marking an Eagle


Attaching Radio Transmitter


Young Visitors Learn About Eagles


Coots at DeGray Lake


Trapping a Sick Coot


Trapping Coots for Banding

Coot That Died from AVM

Learning What Coots Eat

Examining Aquatic Plants in Arkansas

Freshwater Sponge Collection

Collecting Aquatic Plants

Water Quality Analysis

Videos

Field Diagnostic Video

View excerpts from a 1998 CEBLS field diagnostic video showing clinical signs in eagles and coots. A copy of the 11-minute video may be obtained from Julie Marcy, USACE.

Mpeg Format (14.2 MB)
RealPlayer Format

Video Documentary

A VHS documentary, "Saving the Eagles" on this disease (recipient of the first place award (nature and science category) at the Silver State Documentary Film Festival) may be purchased for $24.95 from the:

Arkansas Educational Telecommunications Network
Membership Department/Ancillary Sales
Attn: Pat Pearce
Sesame Street Donaghey
Conway, Arkansas 72032
1-800-662-2386

Partners

Partners currently involved in this effort include:

- Arkansas Department of Parks and Tourism
- Arkansas Department of Pollution Control & Ecology
- Arkansas Educational Television Network
- Arkansas Game & Fish Commission
- Arkansas State University
- Arkansas Natural Heritage Commission
- Arkansas State Livestock & Poultry Commission
- FTN & Associates
- Georgia Power Company
- Henderson State University
- Lake Murray Association
- National Center for Toxicological Research, US Food and Drug Administration
- Ouachita Baptist University
- Ross Foundation
- Savannah River Ecology Lab
- Southeastern Cooperative Wildlife Disease Study
- Texas A&M University
- US Army Corps of Engineers
- USEPA Environmental Chemicals Laboratory
- US Geological Survey National Wildlife Health Center
- US Fish & Wildlife Service
- USDA Poisonous Plant Research Laboratory
- Woodlake Country Club Association

Assistance Needed

You can play an important role in helping researchers solve this wildlife mystery. We are very interested in the geographic distribution of the disease and species it occurs in and can gain insight from reports of new sightings. If you observe birds showing clinical signs of AVM or find accumulations of dead birds, contact your state wildlife and fisheries agency and local office of the US Fish & Wildlife Service. You should then contact a veterinary diagnostic facility such as USGS NWHC or SCWDS to request assistance. Individuals who are authorized to handle protected bird species should chill, not freeze, AVM suspect birds that are found dead.

In addition, you can watch for AVM study birds. During previous research studies in Arkansas, bald eagles were marked with standard aluminum National Bird Banding Lab leg bands, and with green, alphanumeric, aluminum leg bands. American coots were marked in Arkansas with neck bands of white, yellow, orange, light blue, dark blue, green and red. Sightings of these birds should be reported to the Arkansas Game & Fish Commission.

Banding an Eagle

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Banding Coots

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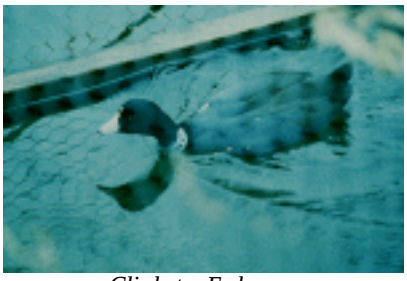
Neckband on Coot



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Links

Arkansas Game & Fish Commission
Georgia Department of Natural Resources
Savannah River Ecology Lab
Southeastern Cooperative Wildlife Disease Study
US Fish and Wildlife Service
USGS National Wildlife Health Center

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PDF File of This Site

Click here for an Adobe Acrobat PDF file of the AVM site.

Adobe® Acrobat® Reader is free, and freely distributable, software that lets you view and print Portable Document Format (PDF) files.

Affected Coot

Back to Clinical Signs

Affected Coot

Photo by Tom Augspurger, USFWS

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Site Map

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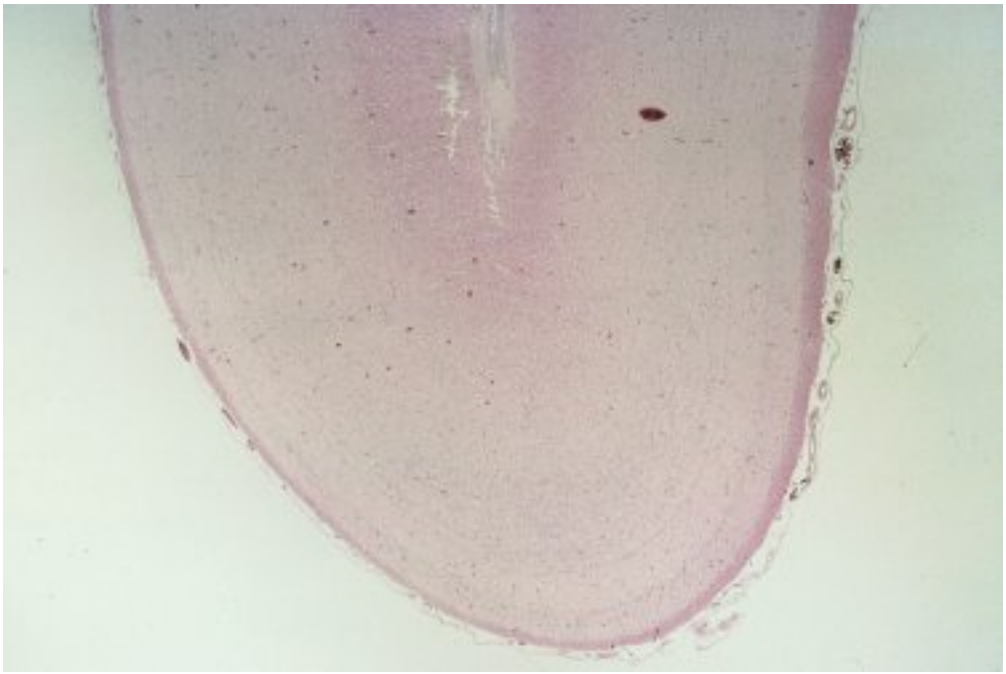
Necropsy of Bald Eagle

Photo courtesy of USGS NWHC

Back to Diagnostic Results

Normal Brain Cell



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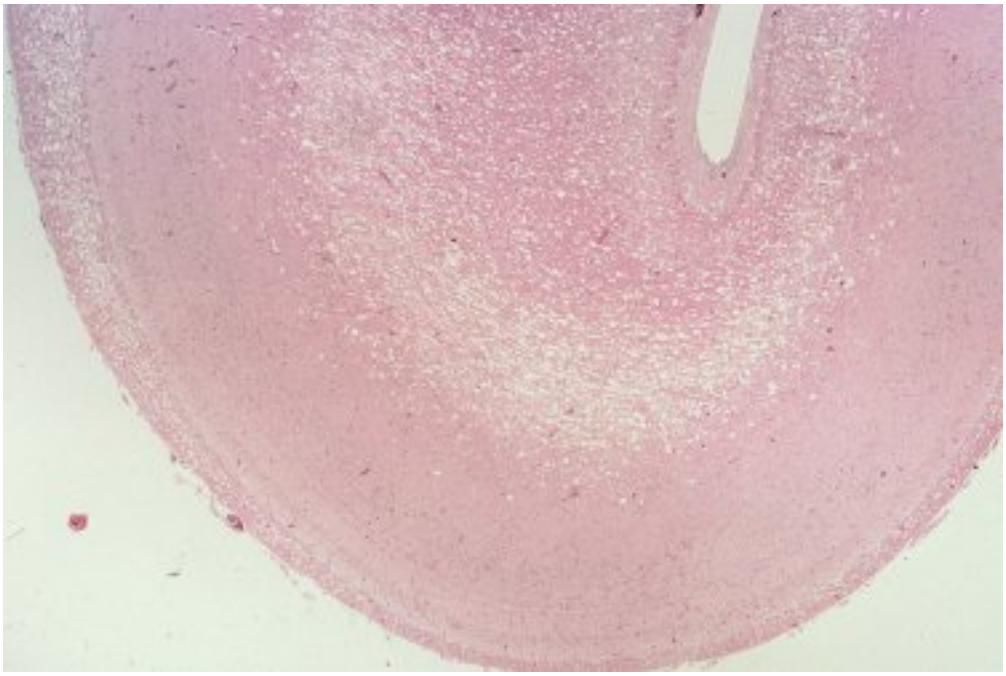
AVM Lesion in Brain Cell



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Banding an Eagle

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Trapping and Banding Coots

Back to Assistance Needed

Neckband on Coot

Back to Assistance Needed